CLAIMS

WE CLAIM:

1. An apparatus for fixing and straightening polymeric molecules, the apparatus comprising:

a micro-channel sized to provide laminar flow of a liquid along a micro-channel length, wherein at least a first wall of the micro-channel provides electrostatic attraction to the polymeric molecule;

means for passing the liquid and polymeric molecule through the micro-channel operating together with the micro-channel to:

(a) straighten the polymeric molecule by passage along the micro-channel within the laminar flow, and

(b) cause adsorption of the polymeric molecule to the first wall of the micro-channel in straightened form.

2. The apparatus of claim 1 wherein the first wall of the micro-channel is transparent.

3. The apparatus of claim 1 wherein the first wall of the micro-channel is glass.

4. The apparatus of claim 1 wherein the first wall is treated to have a positive surface charge of predetermined density.

5. The apparatus of claim 1 including further at least one second wall of the micro-channel provides less electrostatic attraction to the polymeric molecule than the first wall.

6. The apparatus of claim 1 wherein the first wall is detachable from the micro-channel.

7. The apparatus of claim 1 wherein the micro-channel is formed at least in part from poly(dimethylsiloxane).

8. The apparatus of claim 1 wherein the micro-channel size and a rate of flow of the liquid and polymeric molecule is selected so that diffusion of the polymeric molecule dominates sedimentation of the polymeric molecule.

9. The apparatus of claim 1 wherein a width of the micro-channels is between 1 and .01 times the straightened length of the polymeric molecule.

10. The apparatus of claim 1 wherein a width of the micro-channel is less than the diffusion distance of an end of the polymeric molecule during a passage time through the micro-channel.

11. The apparatus of claim 1 wherein a width of the micro-channel is less than 100 micrometers.

12. The apparatus of claim 1 wherein the liquid has a viscosity substantially equal to the viscosity of water.

13. The apparatus of claim 1 wherein the adsorption of the straightened polymeric molecule is preceded by attachment of at least one end of the polymeric molecule to the first wall.

14. The apparatus of claim 1 wherein at least one end of the micro-channel provides a funnel section opening to a reservoir holding the liquid and polymeric molecules.

15. The apparatus of claim 1 wherein the means for passing the liquid and polymeric molecule through the micro-channel is a positive pressure pump attached at one end of the micro-channel.

16. The apparatus of claim 1 wherein the means for passing the liquid and polymeric molecule through the micro-channel is a negative pressure pump attached at one end of the micro-channel.

17. The apparatus of claim 1 wherein the means for passing the liquid and polymeric molecule through the micro-channel is a reservoir acted on by a force resulting from centrifugal acceleration.

18. The apparatus of claim 17 wherein the reservoir is at least end well extending perpendicular to the length of the micro-channel and wherein the apparatus further includes a housing allowing the end well and micro-channel to be received by a centrifuge with the end well extending along a principal axis of centrifugal acceleration and the micro-channel extending substantially across the principal axis of centrifugal acceleration.

19. The apparatus of claim 1 wherein the polymeric molecule is DNA.

20. The apparatus of claim 1 wherein the micro-channel includes a region of varying cross section to promote a gradient in flow rate.

21. A method of straightening and fixing polymeric molecules comprising the steps of:

(a) putting the polymeric molecules in a carrier liquid

(b) passing the polymeric molecules and carrier liquid through a micro-channel having a first wall electrostatically attractive to the polymeric molecule to promote a laminar flow of carrier liquid in the micro-channel causing the polymeric molecule to adhere in straightened configuration to the first wall.

22. The method of claim 21 further including the step of (c) detaching the first wall from the micro-channel.

23. The method of claim 21 further including the step of (c) applying restricting enzymes to the straightened polymeric molecule attached to the first wall.

24. The method of claim 21 further including the step of (c) optically inspecting the straightened polymeric molecule at attached to the first wall.

25. The method of claim 21 further wherein step (b) first causes a straightening of the polymeric molecule in the laminar flow and second causes attachment of one end of the polymeric molecule to the first wall and third causes attachment of the length of the polymeric molecule to the wall.

26. The method of claim 21 wherein the polymeric molecules are treated with a condensation agent to collapse the polymeric molecules into shear resistant balls and

wherein step (a) includes the step of placing the polymeric molecules and carrier liquid into a reservoir attached to the micro-channel and decondensing the polymeric molecules in the reservoir prior to step (b).

27. The method of claim 21 further including the step of treating at least one wall of the micro-channel to have a positive surface charge of predetermined density.

28. A method of manufacturing a micro-channel for straightening and fixing polymeric molecules, comprising the steps of"

(a) preparing a mold of the micro-channels having a base plate and upstanding micro-channel cores

(b) coating the mold with an elastic molding compound

(c) removing the cured elastic molding compound from the mold;

(d) applying the cured elastic molding compound to an optical mapping surface to create micro-channels between the molding compound and the optical mapping surface.

29. The method of claim 28 including the step of treating the optical mapping surface to have a positive surface charge of predetermined density.

30. The method of claim 28 including the step of wherein the optical mapping surface is transparent.

31. The method of claim 28 including the step of wherein the optical mapping surface is glass.

32. The method of claim 28 including the step of wherein the elastic compound is poly(dimethylsiloxane).

33. An apparatus for fixing and straightening polymeric molecules, the apparatus comprising:

a micro-channel sized to provide laminar flow of a liquid along a micro-channel length including a first wall of the micro-channel providing electrostatic attraction to the polymeric molecule;

means for passing the liquid and polymeric molecule through the micro-channel operating together with the micro-channel to:

(a) straighten the polymeric molecule by passage along the micro-channel within the laminar flow, and

(b) cause adsorption of the polymeric molecule to the first wall of the micro-channel in straightened form;

wherein the first wall of the micro-channel is releasably attached to remaining walls of the micro-channel.